THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 101.)

DI.—COLUSA, CAL.

Colusa, California, in lat. 39° 10′ N., long. 122° W., is in the valley of the Sacramento River.

Settled in 1851, it was incorporated in 1870.

Water-works were built by J. B. Cooke, as a private enterprise, in 1870, taking the supply from the Sacramento River and pumping it by a Knowles steam pump 79 ft. into a wooden tank 20 ft. in diameter and 10 ft. high.

Distribution is by 5 miles of pipe of from 7 to 2½ in. diamater, of wrought iron, boiler tubing and bored logs. The last do not give satisfaction. There are 14 fire hydrants, 5 gates, 150 taps and 2 meters. The town pays $300 per year for fire hydrants. Service pipes are of wrought iron.

The population in 1880 was 1,779. The daily consumption in 1882 was 100,000 gallons.

The works have cost $24,000. The expenses in 1882 were $2,800. The receipts are not given.

H. H. Thomas is Superintendent and Engineer.

DII.—WATSONVILLE, CAL.

Watsonville, California, in lat. 37° N., long. 122° W., is on level ground on the Pajaro River, between the Bay of Monterey and the Coast Range.

Settled in 1852, it was incorporated a town ln 1868. Water-works were built by a private company in 1879 after plans of J. B. Culver, C. E., taking the supply from Corralitos Creek, a mountain stream 7 miles N. of this town. The water is conveyed 5 miles in a flume of redwood 12 by 15 in. to a reservoir 125 by 175 ft., in excavation in hard clay, holding 2,000,000 gallons 90 ft., above the town, and 2 miles from it. It is conveyed to the town by an 8-in. riveted pipe of No. 14 sheet iron and is distributed by 4 miles of wrought iron pipe of from 6 to 1 in. diameter, with 16 fire hydrants, 25 gates and 300 taps. Mains and services are of wrought iron coated with asphalt. The town pays $600 per year for public water.

The population in 1880 was 1,799. The daily consumption is not given.

The works have cost $51,885. There is no debt. The expenses in 1882 were $2,046.23. The receipts are not given. The works are owned by Francis Smith & Co. A. White is the Superintendent.

DIII.—MIDDLETOWN, O.

Middletown Ohio, in lat. 39°, 30′ N. long 86° 40′ W. is on level ground on the Big Miami River.

Settled in 1815, it was incorporated a village in 1835. Water-works were built in 1872 by the Holly Manufacturing Company, for the town, taking the supply from a well 20 ft. in diameter and 33 ft. deep and pumping directly into the mains by Holly pumps driven by water-power. The ordinary presure maintained is 40 pounds and the fire pressure 90 to 110 pounds.

Distribution is by 12 miles of cast-iron pipe of from 14 to 4 in. diameter with 100 fire hydrants, 46 gates and 283 taps and 6 meters. The city pays the interest on the bonds. Service pipes are of lead.

The population in 1880 was 4,538 and the daily consumption in 1882 was 15,000 gallons.

The works cost $74,000. The bonded debt is $68,000 at 8 per cent. which will be reduced to 5 per cent. in 1883.

The expenses in 1882 were $675 and the receipts $3,000.

The works are controlled by three trustees. H. P. Clough is chairman of the water committee of the City Council.

DIV.—EAST ORANGE, N. J.

East Orange, New Jersey, in lat. 40° 45′ N., long. 74° 20′ W., is on undulating ground, lying in ridges, about 160 ft. above tide water, parallel to the Passaic River and five miles west of it.

Settled about 1666, it was set off from the town of Orange in 1862.

Water-works were built by a private company in 1882, taking the supply from three deep wells drilled in sandstone 85 to 108 ft. The water is pumped directly from the wells, which are connected by the suction pipe of the pumps. The pumps, of 12-inch diameter and 18-inch stroke, built by the Holly Manufacturing Company, pump directly into the mains, with ordinary pressure of 70 pounds and fire pressure 120 pounds. Distribution is by 11 miles of cast-iron pipe of from 12 to 4 in. in diameter, with 102 fire hydrants, 25 gates and 91 taps. The town pays $60 per year for each hydrant. Service pipes are of lead.

The population in 1880 was 8,349.

The works have cost $105,000. They have just gone into operation.

F. M. Shepard is President.

DV.—BRANDON, VT.

Brandon, Vermont, in lat. 43° 45′ N., long. 73° 45′ W., on the western slope of the Green Mountains is on Otter Creek.

Settled in 1774, it is incorporated as a fire district. Water-works were built for the district in 1879, by R. D. Wood & Co., taking the supply from Hitchcock Pond in the mountains, of about ½ square mile area, with gravelly bottom, 5½ miles from the village and 150 to 180 feet above it.

A 12-in. cast-iron pipe is laid out into 14 ft. water, and extends 1 mile toward the village and is then reduced to 8 in. and continued to and through the village with 6-in. pipe in cross streets. There are 2½ miles of pipe in the village with 35 fire hydrants, 13 gates and 260 taps. Service pipes are of galvanized iron.

The population in 1880 was 3,280. The consumption is not known.

The works cost $40,000, which is the bonded debt at 5 per cent. interest.

The expenses in 1881 were $365.86 for repairs to frozen pipes. The receipts were $1,386.91.

The works are managed by the Prudential Committee, C. W. Briggs, chairman.

DVI.—SAND BEACH, MICH.

Sand Beach, Michigan, in lat. 43° 45′ N., lon. 82° 35′ W., is on level ground on the shore of Lake Huron.

Settled in 1850, it was incorporated a village in 1882.

Water-works were built by a private company in 1881, taking the supply from Lake Huron and pumping directly into the mains by a steam pump after designs of Mr. Walker. The ordinary pressure maintained is 20 lbs., and the fire pressure 90 lbs.

Distribution is 1½ miles of Wyckoff wooden pipe of from 5 to 1½ in. diameter, with 12 fire hydrants and 5 taps. The village does not pay for hydrants. The kind of service pipe used is not stated.

The population in 1880 was 534. The daily consumption is not known.

The works cost $4,000. They were built principally for protection against fire, and are owned by J. Jenks & Co.

(TO BE CONTINUED.)

The receipt of statistics as follows is acknowledged with thanks:

From the Holly Manufacturing Co., statistics of Selina, Kansas, by J. E. Bonebrake, President; of Independence, Mo.; of Rock Island, Ill., by F. A. Cramer, Superintendent; and of Fredericton, N. B. From Chester B. Davis, Chief Engineer, statistics of Madison, Wis., water-works. From J. P. Minchin, President, Report of Evart, Mich., Water Board for 1881. From J. Jenks, statistics of Sand Beach, Mich., water-works. Prom W. W. Snow, Superintendent Ramapo W. and F. Co., statistics of Hillburn, N. Y., water-works. From W. R. Freeman, statistics of San Antonio, Texas, water-works.

CORRECTIONS.—*Jan.* 6, 1883, *p.* 10.—*Hornellsville, N. Y.*—S. H. Crane, Secretary and Treasurer, corrects statistics as follows: Dam is 27 ft. high and 244 ft. above the village. Distribution pipes are of 16, 10, 8, 6 and 4 in. diameter. There are 123 fire hydrants and 200 taps. Service pipes are of wrought iron and galvanized iron. The charges for water began Jan. 1, 1883.

Feb. 17, 1883, *p.* 80.—*Cooperstown, N. Y.*—The old pipes which were *not* coated with coal tar, soon gave out. The joints of the supply main laid in the lake was caulked with *pine* wedges, not *five*.

Glens Falls, N. Y.—The upper dam and reservoir were built in 1878, after the plans and under the superintendence of W. H. Vibbard, C. E. P. P. Robbins & Son were the contractors.

THE REAL INVENTOR OF THE STEAMBOAT.

A statue of Robert Fulton has been erected in the national Hall of Statuary, in the Capitol, to represent Pennsylvania. Robert Fulton is generally credited with being the inventor of the steamboat; and by many people he is also supposed to have been a native of New York. Both of these notions are erroneous. He was not the inventor of the steamboat; and he *was* a native of Pennsylvania.

The inventor of the steamboat was John Fitch. This remarkable man, a native of that part of old Windsor that is on the east side of the Connecticut River and is now included in the newer township of South Windsor, conceived the idea of a steamboat while living in Philadelphia, in 1784, twenty-three years before Fulton started *his* boat. Fitch went ahead with his idea—petitioned Congress in 1785 for aid to build his vessel, and submitted his model to the American Philosophical Society of Philadelphia. He received some assistance from individuals, went ahead, built a boat, the Perseverance, and had it in actual operation on the Delaware on the 1st of May, 1787. His engine was the first double-acting condensing engine transmitting power by means of cranks ever constructed. The boat made several trips up and down the river; but, owing to the difficulty of keeping the piston tight against the comparatively rough interior surface of the cylinder, the rate was slow—only three miles an hour. Fitch then improved it, so that, in 1788, it made eight miles per hour. It was then put into regular use on the Delaware.

Fulton saw it—and in a later year saw Fitch's model in Paris, where the inventor had taken it in the vain hope of getting French artisans to build a steamer. Fulton, who, unlike Fitch, had the important aid of wealthy friends, failed in an invention of a submarine torpedo boat. Then he undertook, some seventeen years after Fitch's triumphant demonstration on the Delaware, to make a steamboat to ply on the Seine, at Paris; but it proved a total failure. He then went to England and Scotland, and studied up the mechanism of a steam canal towboat, which, built on a wrong principle, was trying to do work on the Clyde. Having the means, he bought a powerful engine, of Watt's invention, in England, in 1806, and sent it to the United States, where, in 1807, he got it at work in the first Hudson River steamer, the Clermont. This boat made five miles an hour up stream—not equal to Fitch's boat on the Delaware, twenty years before.

But Fitch was poor, and destined always to bitter trials and disappointments. Fulton had powerful friends, and obtained unjustly the credit of being the inventor of the steamboat. Fitch died in disappointment and obscurity in Kentucky, by an overdose of opium; Fulton goes into the Hall of Statuary in the Capital. But history will yet right this matter and do justice to John Fitch.—*Hartford Daily Times.*

THE MANUFACTURE OF DYNAMITE.

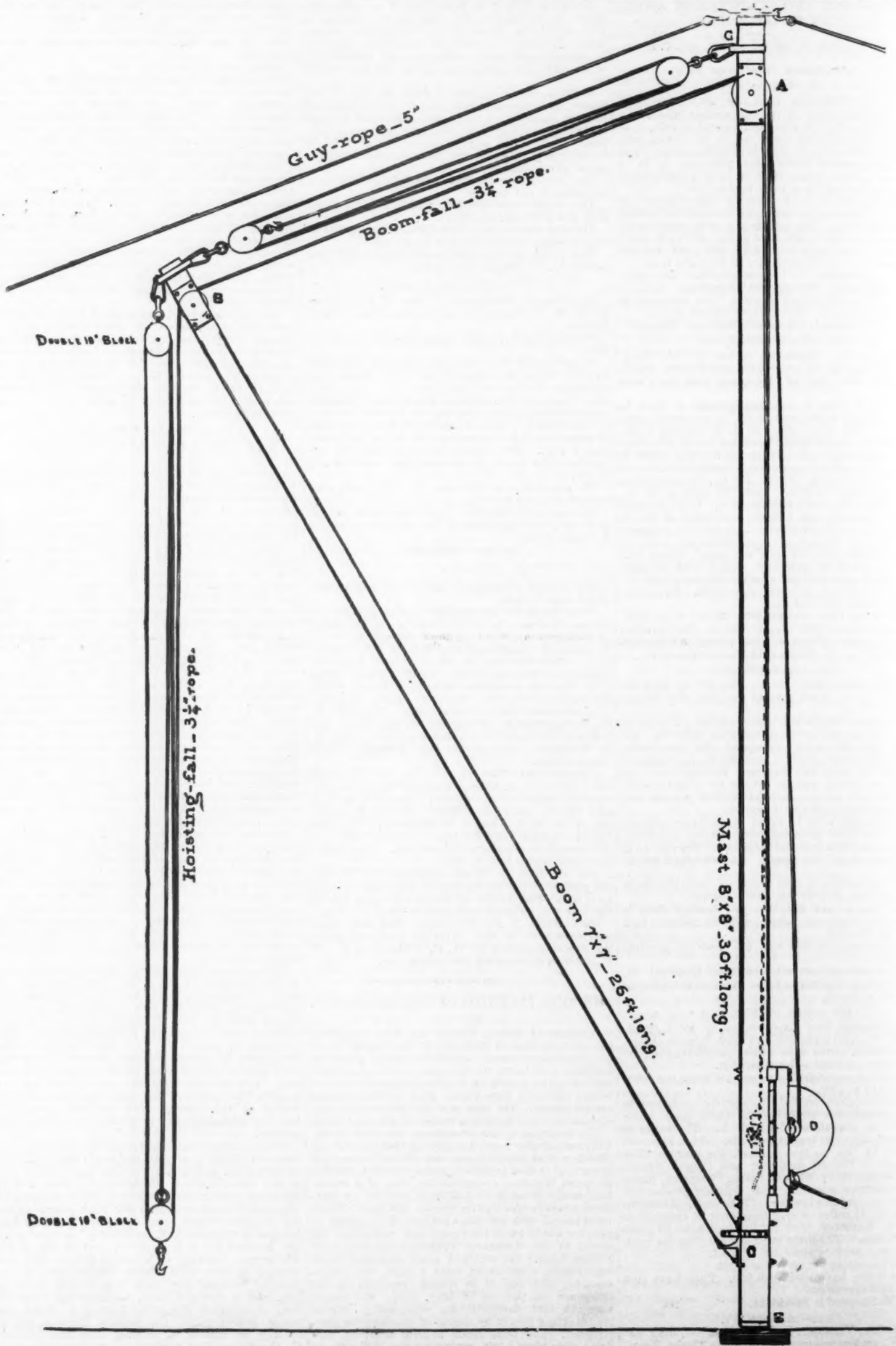
On the coast of Ayrshire, a few miles south of Ardrossan, are located the works of the British Dynamite Company. Though not in any way offensive, as regards bad odors, nor inimical to health, nor injurious to either animal or vegetable life, yet they are located one mile from the nearest village, no doubt with a view of reducing the loss of life in the event of an explosion, though so perfect are the police regulations of the place itself that the danger is almost *nil*. Some two hundred and fifty men and women are employed in the works, and when they enter the gates in the morning they become virtually prisoners for the day; but their healthy, contented faces and cheery voices give ample evidence that they like the work and do not fret at their voluntary confinement.

The day's work is commenced by all hands changing their ordinary clothing for a uniform, differing for each gang, and each distinctive of the special work to be performed by this particular gang. This uniform plays an important part in the safety precautions of the establishment. Realizing that accidents usually occur in dangerous occupations on account of some one undertaking to do something with which he is not thoroughly familiar, the management have adopted these distinctive uniforms (in one instance bright red), so that the police can tell at a glance whether any one is out of his or her province.

Four men from the county police force, paid by company, are constantly patrolling the premises (which cover an area of a square mile), and they can neither speak nor be spoken to. The superintendent is a man intimately acquainted with all the theoretical and practical aspects of the question of manufacture, besides which, at irregular and uncertain intervals, a government official visits the place to see that the acts of Parliament relative to the manufacture of dynamite are faithfully carried out.

The process followed in the manufacture is based on the discovery of Mr. Nobel, that by the use of an inert substance the power of the explosive is not lessened, while the risk attending its application is reduced. The substance used is a porous, silicious earth, resembling flour, into which nitroglycerine is poured and by it absorbed, when the compound is passed through various processes, each with a view of lessening the danger of handling. It is then made up into cartridges of various lengths and power. The cartridge material, divested of the agency of a detonator, may be handled and subjected to percussion without explosion.

There are limits as to the quantity which may be sent out at any one time, and there are rules laid down for the arrangement no less than for the size of the cases holding the material. That it is a profitable undertaking in which the company are engaged is apparent from the high premium on the original shares; and that their product has become a "resource of civilization" is shown by the demand for it from every part of the globe where man, warring with nature, is uprooting the stumps of trees that hinder the progress of his plough, leveling the rock that comes between him and a straight path, unloosening from its firm foundation the stone that is to build his house, breaking into the seam of the coal that is to cook his dinner, or making deep and navigable the stream that gives him communication with his neighbor.—*Medical and Surgical Reporter.*



THIRTY-FEET HAND DERRICK.

THIRTY-FEET HAND DERRICK.

EDITOR ENGINEERING NEWS:

After your very complimentary editorial note in ENGINEERING NEWS of Jan. 27, I cannot refuse your request, and so I send you drawings of a hand-geared derrick with 30 ft. mast. While it may not be the best that could be designed, it is convenient, easily and cheaply constructed. There are many occasions for using a light, portable derrick, when one would not consider it worth while to set up a large one, such as you illustrated recently. For instance, in digging a well, take the 30-ft. derrick with a single block to raise the tub, remove the crank shaft and drum and in their place attach a snatch block; then, with a good pair of horses, you can hoist a tub full of earth quickly, and swing it so as to dump 40 ft. away from the well.

For loading and unloading stone or heavy timber or for building a heap of coal, as well as building masonry under a bridge, a small derrick will save its cost in a year. Of course a large derrick is much better for big work and is oftentimes indispensable, but such a one as my drawings represent will prove to be "a handy trick" as they say in Texas.

THIRTY-FEET HAND DERRICK,

Mast 8 in. × 8 in., 30 ft. long, square timber corners chamfered off except when gearing and sheaves are attached. Boom 7 in. × 7 in. or 8 in. × 8 in., 26 ft. long, corners chamfered off except at base. Butt to be rounded to a half circle with pin hole at center of circle. At *A* are two 10-in. × 1¼-in. sheaves, one on each side of mast. Hoisting fall passes over one and boom fall over the other. At *B* is a single 8-in. × 1¼-in. sheave attached to the boom in the same way as those at mast-head; if preferred this sheave could be placed in a mortise through the center of the boom. At *C* is a cast-iron bracket with rib at top and bottom, secured to mast by three bolts, two above and one below. The *U*-shaped band passing around the mast holds the boom in place, but the bracket supports all the weight. The detail drawings will, I think, explain the construction of the remaining parts. The design was to make all the iron work as simple as possible, and strong enough for the work. The step casting should be bolted with ¾-in. lag screws to a block of oak, say 16 × 20 in. and 4 in. thick. There should be two bolts through the oak piece horizontally, projecting 4 in. on each side, to serve as fulcrums for bars in moving the derrick. I do not claim anything about this derrick as original with me, and many of your readers may know of better ones, but as I had the drawings on hand you are welcome to the tracings sent.

For guys I would use 400 ft. of 5 in. rope, a hook to be spliced on to one end of each guy. For hoisting fall and boom fall, say 500 ft. of 3¼-in. rope. For blocks you will need two plain double 10-in. blocks, one ditto with becket, and one ditto with becket and loose swivel hook.

In regard to hoisting engines, if you have a winch head on the down shaft, and have a loose drum instead of a loose pinion as some engines have you can handle two falls at the engine, but this requires an extra man to the line on the winch head. An engine with two drums would be better, also heavier and more costly. Trusting that my contribution will induce others to send in drawings of contractors' plant, I am,

Yours truly, T. APPLETON.

COUNCIL BLUFFS, Kan., Feb. 2, 1883.

NEW BRIDGES.—The Indianapolis *Journal* of March 2 says: "W. C. Irwin, engineer of bridges on the Bee Line system, is in the city, and last evening stated that next week he would advertise for some $1,500 feet of new iron bridges on the Indianapolis & St. Louis division. New bridges are to be built across the Eel River at Fern, White Lick at Avon, over the Embarrass River, and a 150-ft. span is to be added to the bridge over the Wabash River at Terre Haute. On this division $50,000 is to be expended in replacing piling, on which bridges rest, with stone abutments. On the Indianapolis division of the Bee Line bridges of 150-ft. span each are to be built across streams at Yorktown, Muncie and Winchester."

ENGINEERS' SOCIETIES.

LIVERPOOL ENGINEERING SOCIETY.

The third meeting of the session was held on Wednesday, the 14th ult., at the Royal Institution, Colquitt street, Mr. R. R. Bevis, Jun., in the chair, when a paper entitled "Notes on the Steam Engine Indicator" was read by Mr. W. C. Pagan. After a few introductory remarks upon the instrument itself, the author proceeded to trace its gradual development from its invention by the great James Watt to the instruments used at the present day. Taking the leading types for comparison, he pointed out their respective advantages, and gave some general hints as to the fixing of the instrument, remarking, in conclusion, that though the diagrams produced by the indicator might be accepted as a delineation of the pressure and its position as existing in any vessel, it should not be relied on as an absolutely correct measurer of the power developed by an engine.

ENGINEERS' CLUB OF PHILADELPHIA.

ROOMS, NO. 1,523 CHESTNUT ST., PHILADELPHIA, PA.

Record of Regular Meeting, Feb. 17, 1883.

President Henry G. Morris in the chair; 23 members and one visitor present.

The Secretary presented, for Mr. J. M. Stewart, the following description of the Delaware Breakwater Harbor Improvement:

The construction of the Delaware Breakwater was commenced in the year 1829, upon plans submitted by a Board of Commissioners appointed by the Congress of the United States.

The project of the Board contemplated the construction, in the concavity of the Delaware Bay, just inside Cape Henlopen, of two massive works on the "pierres-perdues" or rip-rap system, separated by an interval or "gap" of about one-quarter of a mile; the greater, called the "Breakwater," to be about twenty-six hundred (2,600) feet long, and fourteen (14) feet above low water, to afford safe anchorage during gales from the north and east; the other, called the "Ice Breaker," to be about one-half the length of the greater work, and of the same height, to protect shipping against northwesterly gales and heavy drifting ice of the bay.

The stone used in the construction of these works was uncut, and varied from one-quarter of a ton to seven tons in weight, the smaller constituting the bulk of the mass, the larger being used to cover the exterior slopes and to sustain the direct impact of the sea.

During ten years the progress of construction was such that by 1839, eight hundred and thirty-five thousand (835,000) tons had been deposited. From this time on, work was done irregularly, until 1869, when the works were completed as they stand at present.

The Breakwater is two thousand five hundred and fifty-eight (2,558) feet long on the top; the Ice Breaker thirteen hundred and fifty-nine (1,359) feet. The average width of both is twenty-two (22) feet on top, one hundred and sixty (160) feet at the base, and each is about fourteen (14) feet above mean low water.

The Breakwater Harbor for many years fulfilled, so far as its capacity enabled it, the design of its projectors in protecting the commerce of the country. But the growth of this commerce, particularly the last twenty-five years, has so far exceeded possible anticipation as to practically exclude more than a fractional part from the intended shelter. At various times, therefore, projects looking to the enlargement of the protected area have been the subject of deliberation by officers and boards of engineers; and the matter received renewed attention during the fiscal year just closed, from the reference by the Chief of Engineers of the U. S. A. to a report of Major Wm. Ludlow, Corps of Engineers, U. S. A., showing by comparison of a recent survey with former ones, that not only was the protected area yearly diminishing relatively to the amount of shipping seeking shelter, but was also undergoing a positive and serious deterioration from a marked decrease in depth. In view of this deterioration, a board of engineers recommended as a possible remedy the closing of the "Gap" existing between the Breakwater and adjoining Ice Breaker, which, it is believed, will to a greater or less extent check further deposits within the harbor, and remove those existing on the shoals in its vicinity, and also increase the protected area of anchorage nearly four-fold.

It is proposed to close this "Gap" by means of a concrete superstructure resting upon a granite rip-rap foundation, described generally as follows:

A bridge of creosoted timber is first to be constructed completely across the "Gap," with bays of sixteen feet long. Each trestle is to be formed of three piles, the center pile vertical, the others inclined, and forming with the cap a profile for the concrete work. A double railroad track is to be laid on the bridge for the transportation of material.

Upon the completion of the bridge, it is proposed to begin the deposit of the rip-rap (the granite used weighing not less than one ton, the average being three to the block), laying the same uniformly across the "Gap" to prevent scouring of the bottom, and to gradually raise the height of the rip-rap to twelve (12) feet below mean low water, with a width of forty-eight (48) feet on top, and a side slope of one-half on one.

The concrete superstructure is to begin twelve (12) feet below low water, with a base of twenty-four (24) feet wide, height twenty-four (24) feet, side slope of four (4) on one (1) and a width on top of twelve (12) feet.

The concrete is to be built in blocks of the above cross-section and length of sixteen (16) feet, corresponding to the length of the bays of the bridge. For this purpose the bays are to be inclosed with detachable aprons forming boxes, to be filled in succesion, the boxes containing at each end a triangular re-entrant, which, after the two adjoining boxes have been filled, can be taken down and likewise filled, forming square plugs to bind together the larger blocks. To hold the said aprons in position, tie-rods will be used, passing through pipes, the extremities of which will be flush with the exterior surface of the concrete.

The aprons and tie-rods used in the construction of each block can be removed and used again as soon as the mass shall have attained the requisite solidity.

The closing of the "Gap" between the Ice Breaker and Breakwater will be begun at once, and it is expected that the work will be completed in about five years.

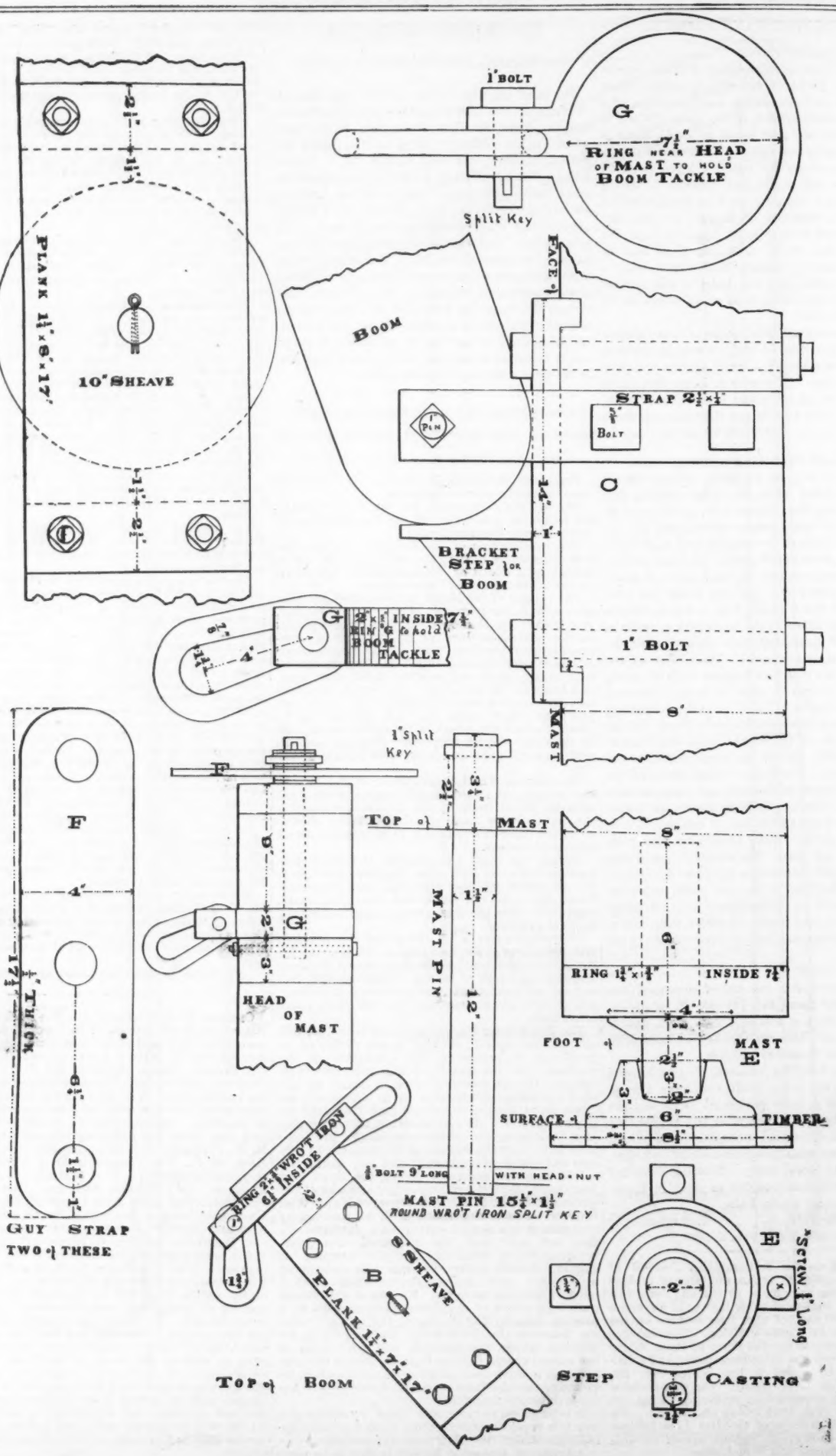
The Secretary suggested that the members present should give their views with regard to the best methods to be pursued in the preparation of the proposed Club Pocket Book. Messrs. Howard, Constable, Boyd, Dr. Chance, the Secretary and others discussed the subject at some length, and it seems to be the unanimous opinion that it can be made a very valuable work. The main points derived from the discussion seem to be that it would be more convenient to use larger print than is usual in pocket books, and that the design should be rather to compile *a ready reference book* of convenient size than a book sufficiently small for for carrying in the pocket. There is some difference of opinion as to detail but, inasmuch as it will be furnished in separate sheets, each member can use his own judgment in compiling his individual copies, and in determining which of the sheets he will insert in field or *pocket* book.

Dr. H. M. Chance reported his experience with the Loiseau Fuel in domestic use. He found the ash low in weight, but high in bulk. His conclusion was that it is a good fuel for open grates and for manufacturing purposes.

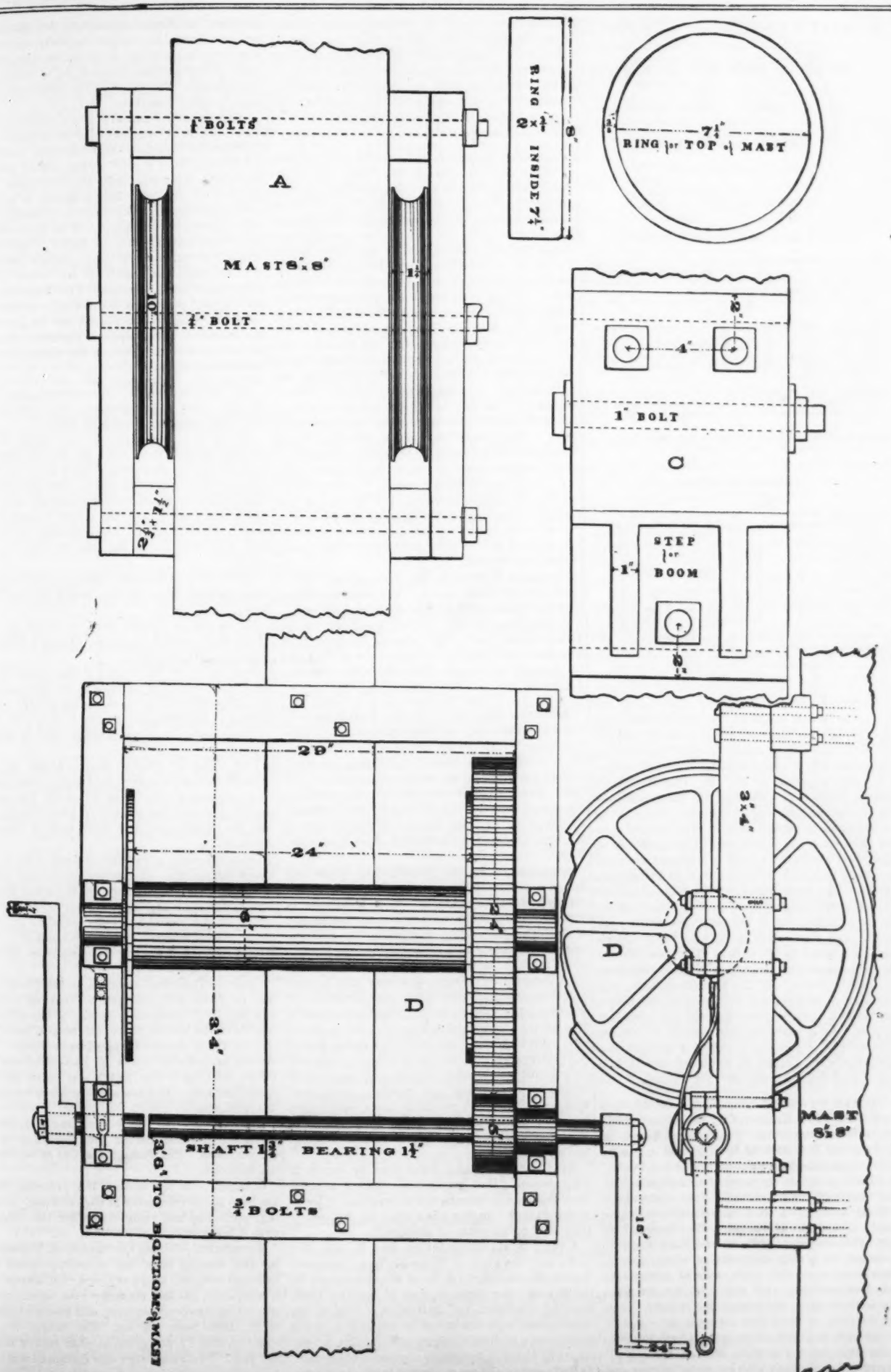
The Secretary called attention to a letter from Mr. E. H. Talbott, Secretary of the National Exposition of Railway Appliances, requesting co-operation in obtaining, or bringing to his notice, any articles, new or old, appropriate to that Exposition.

HOWARD MURPHY, Secretary and Treasurer.

ONTARIO PACIFIC RAILROAD.—The stock of $300,000 required by the act of incorporation having been subscribed, and 10 per cent. paid thereon and deposited in the Ontario Bank, the shareholders of the Ontario Pacific Railway met in the town of Cornwall and elected a board of nine directors for the ensuing year. The meeting was unanimous in proceeding with the work of construction as soon as possible. Subsequently the board of directors met and chose the following officers: D. Bergin, M. P., President and Managing Director; Joseph Kerr, M. P., Vice-President; D. A. Fleck, Secretary and Treasurer; J. L. P. O'Hanly, C. E., Chief Engineer; John Bergin, Solicitor. The Ontario Pacific Railway starts from Cornwall, touching at Harrison's Corners, Newington, South Finch, Berwick and Chrysler, to Ottawa, thence by Arnprior and Eganville, to French River and Sault Ste. Marie, with branches from the main line at Newington via West Winchester, to Perth and Carleton Place, and from Eganville to Pembroke. Surveys of the entire route will be commenced with the opening of Spring, and pushed forward vigorously to completion. The Directors expect to be able to put that portion of the main line between Cornwall and Arnprior under contract by the 1st of August next, as well as the whole of the Perth branch. So desirous are the board to hurry up the work that they have instructed their engineer to proceed at once with the survey of the line through Ottawa city and suburbs; and accordingly a staff of engineers will be at work next week locating the line in the city and vicinity. Chief offices at Ottawa Canada.



DETAILS OF THIRTY-FEET HAND DERRICK.



DETAILS OF THIRTY-FEET HAND DERRICK.

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.

Tribune Building, New York City.

The Engineering News Publishing Company, Proprietor.

GEO. H. FROST, Treasurer.

SATURDAY, MARCH 10, 1883.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe and Mexico, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belong to the province of this journal is solicited.

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ELECTRO MAGNETS.—Anything from the pen of the great French physicist, TH. DU MONCEL, may be received with that confidence which is only inspired by long and successful work. This work is a translation of the second edition on Electro Magnets, and appears as No. 64, Van Nostrand's Science Series. It considers the construction of the electro-magnet, simple formulæ being given for obtaining the dimensions of the core and wire and the coils of the helices, etc. The conditions of maximum effects by the use of different currents are clearly explained, and the laws thus deduced are applied to the construction. The effects of saturation of electro-magnets and the conditions affecting the arrangement of the cells of a battery are given. The statements made have been experimentally proved by the writer. The laws governing the construction and action of electro-magnets are simply stated, and the gradations from one condition to another are so clearly placed before the reader that the connecting links are never lost sight of. As a work for the student or for the amateur who is striving to obtain a glimpse of a most important branch of electrical science, it is one of the best, if not the best, yet written.

HALIFAX DRY DOCK.—We have received from the author, E. H. Keating, City Engineer of Halifax, a most interesting "Preliminary Report on the Proposed Dry Dock at Halifax, and a general report upon American Stone and Wooden Docks." Mr. Keating, within the pages of a small pamphlet, has condensed more valuable data upon dock-building in America than can elsewhere be procured. The docks at Portland, Me., Boston, New York, Philadelphia, Baltimore and Norfolk are all described, by giving character of work, general dimensions, cost and their several advantages and disadvantages, and dates of construction. The author, after discussing the relative cost and duration of wood and masonry or concrete, as materials of construction in dock-building concludes that for the latitude of Halifax, a well-constructed dock, built with concrete backing and granite face, would be the best suited—a concrete backing with pitch pine face, would stand next as regards cost, and prove an excellent and serviceable structure for a number of years.

To those interested in this subject, we would say that a very limited number of these pamphlets are on sale, and can be had by applying to the office of the City Engineer of Halifax. Price, 60 cents.

A LITTLE INCIDENT IN LOWELL.—A laughable incident occurred during the recent visit of the American Society of Civil Engineers to Lowell, where they were the guests of Mr. J. B. FRANCIS, whose residence is in close proximity to that of Governor BUTLER. Mr. FRANCIS had provided carriages for the conveyance of his guests (about seventy in number) from the railway station to his dwelling, and as they moved slowly in the direction of Governor BUTLER'S place, many rumors were set afloat regarding the nature of the delegation they contained. When within a short distance of the Governor's house, a lady, who also resided in the neighborhood, relieved the curiosity of the inquiring crowd by venturing the observation that the visitors must be the convicts from Concord prison on their way to pay their respects to Governor BUTLER for his kindness and leniency toward them. This "news" spread like wildfire, and a stampede was instantly made in the direction of the Governor's house to see them alight and enter in. The disappointment of the would-be sight-seers when they discovered that instead of the Concord convicts the carriages contained only a lot of civil engineers, paying a visit to the ex-president of their society can easily be imagined. —*Boston Advertiser, 5th.*

[There are mistakes in the above which only a Boston reporter can make. The visiting society was the "American Institute of Mining Engineers." The American Society of Civil Engineers visited Lowell as the guest of Mr. Francis, in June, 1878. The pleasant memories of that visit will no doubt be equaled by those of the fortunate "Mining Engineers."]

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the regular meeting on Wednesday evening, Vice-President W. H. PAINE occupied the chair, and there were present about twenty-five members. Ballots for election of members resulted as follows: HORACE DELPHOS GATES, Civil Engineer, San Francisco, Cal.; GUSTAV LEHLBACH, Civil Engineer, Newark, N. J. For Junior: WILLIAM JEWETT HASKINS, Croton Aqueduct Dept., New York City, N. J.

Amendments to the Constitution were both lost, the latter—the commuting of yearly dues—simply by careless voting of three members. A communication from the Engineering Association of Michigan University, requesting the co-operation of the Society with other engineering associations relative to the granting of the degree of Civil Engineer by colleges, was read and a committee appointed to take it into consideration. In discussing the subject, Mr. SHINN remarked that it was not the province of colleges to grant a degree of "Civil Engineer," any more than it was that of "Attorney-at-law." Graduates of law schools only become attorneys after considerable practice in office and court-rooms, and graduates from engineering schools had much to learn before they became civil engineers. A degree of "Bachelor or Master, of Engineering" was quite as far as a college had a right to go.

Mr. COOPER begged to differ from Mr. SHINN in his statement "that it required years of practice for a graduate to become a civil engineer;" he remembers that "he was wiser when he left college than after many years of practice."

A paper by HAMILTON SMITH, JR., M. Am. Soc. C. E., on "The Flow of Water in Pipes," was read. It gave the tabulated results of 88 experiments on the flow of water through pipes of varying sizes, material, condition and inclination. Most of the experiments were conducted by the author in his practice as a hydraulic engineer in California; the others by eminent hydraulic engineers elsewhere. At first reading, the paper seemed to be a very valuable one, but discussion, mostly by Mr. EMERY, who has studied the subject carefully, showed that these experiments, like most similar ones, did not enter sufficiently into details to be of much value to engineers. The paper will be published and further discussed hereafter.

After the adjournment of the meeting a pleasant innovation in the past habits of the Society was introduced, by Secretary Bogart inviting those present to partake of a *petit souper*, quietly prepared while they were discussing the dry details of the paper of the evening. This collation is provided by a small voluntary contribution of members, and will be given once a month. It is experimental, but if the first one was an augur of the future, they are bound to be a very pleasant feature of the meetings. Refreshments are served at the meetings of the Institution of Civil Engineers, and serve a good purpose, and there is no reason why a similar social feature should not be popular in the rooms of the American Society. Secretary Bogart was congratulated on the happy success of his innovation.

THE PANAMA CANAL.—(*Translated from Bulletin du Canal Interoceanique.*)—The last reports cover the month of December, 1882:

COLON.—The work upon the wharf is progressing steadily to an end; the last 28 piles have been driven, to an average depth of 26 to 28 ft., and the bracing is all in place. The embankment connecting the wharf with the land has been completed and a track laid the entire length of the wharf, which is 377 ft. The unloading of the first ship was commenced on Dec. 26 from the new wharf.

The railway is finished, leading to the company's new material depot at the mouth of the Folk's River.

550 cu. yds. of rip-rap have been put in place at the mole since last report, obtained from the quarry at Kenny's Bluff.

THE DREDGING OF FOLK'S RIVER.—Two dredgers are at work here; at present the average quantity of work done by each dredge is 2,875 cu. yds per day. The dredged material is sand and disintegrated coral; it is an excellent ballast for the railway.

THE YARD AT MONKEY-HILL.—53,037 cu. yds. of earth have been moved here during the month. One excavator has been at work the whole month, a second one was put to work during the last two days, and two more will be added in January.

GORGONA.—An excavator arrived here at the end of the month. The timber has all been cleared away between this place and the Matuchin Ravine, and a "Decauville" railway put down for the transport of material necessary for work upon the rising ground between stations 43.2 and 43.7. The largest number of workmen employed on this section per day has been 100.

OBISPO.—The canal is opened on the Obispo section at seven different points, between stations 45.3 and 47.6, without counting a second canal outside of the line of the canal proper, near sta. 48.7, as a new channel for the Obispo River. The volume of material moved in December was 46,000 cu. yds., of which 15,129 was earth and the remainder rock. The average number of workmen has been 326.

EMPERADOR.—The two locomotives in service at this place have transported 1,687 car-loads of 5.3 cu. yds. each. The average number of workmen has been 496.

CULEBRA.—On this section the principal work has been the development of the railways. A section work-shop and round-house for the locomotives is being built.

MACHINERY.—During the month of December, the first floating stage for unloading vessels was launched from the shops at Colon; the second one is completed, but not launched; six boom cranes of a lifting power of six tons, and sweep of about 17 ft., have been put up. The dredge No. 3, tested on Dec. 17, has given as good results as the first two. Two excavators, one European and one American, have also been finished.

"THE ENGINEERING NEWS QUARTERLY."

In announcing the early issue of this new engineering enterprise, we can write no better introduction, than by plainly setting forth the reasons which have induced us to enter on its publication.

We will first mention, however, that "ENGINEERING NEWS AND AMERICAN CONTRACT JOURNAL," will be issued as heretofore; we mean to constantly add to its attractions, and to the best of our ability make it all that its name implies—a newspaper for engineers and all who are associated with them by business; to record, week by week, the doings of corporations and individuals, the advent and progress at home and abroad of all that may be of interest to the profession.

But there is a field in engineering literature for which a weekly publication is not adapted, by reason of the bulk of matter to be disposed of, the time and labor required to select and arrange, and the profuse illustration absolutely required to make the matter acceptable and more intelligible; it is this field that we now aim to reach in our "Quarterly."

We append a partial list of American and foreign engineering periodicals that now reach our office in the way of exchange. Scattered through this material is a mass of engineering information of great value, that we cannot reproduce within the limits of our present journal. This material is rarely re-published in this country, and to the great proportion of our engineers is practically inaccessible; and we believe that a judicious selection of all that is not purely local in its value, will prove a welcome addition to the engineering literature of the day.

We are fully aware that such an enterprise as we propose will require money and labor, very judiciously expended, to make it a success; but we are prepared to make the venture, and confidently rely upon the reading members of the profession for our support. No one can complain of the figure at which the subscription is fixed, especially when that figure is compared with the cost of only one of the many sources of information already at our disposal; nor when he considers that in case of the foreign journals, he gets much that to him is chaff along with each golden grain of useful knowledge.

We have provided for careful translation of the French and other continental engineering publications, and can thus give much data, that to the majority of American engineers would be useless in its present form. And from the proceedings of the Engineering Societies, the best of which, in America and Europe, reach us upon issue, we can give our readers the benefit of actual engineering experience that is now only open to the individual members of such societies.

We propose to issue the first number of "THE ENGINEERING NEWS QUARTERLY" on or about April 15, and thereafter quarterly, as its name implies. Each number will contain 96 pages, uniform in size and general appearance with ENGINEERING NEWS. It will be printed with clear type upon good paper, and in contents each number will present about twelve times the bulk of subject matter now contained in this journal. It will be profusely illustrated, a feature that cannot fail to commend itself to the Engineer, knowing as he does that very often a single cut will convey more real information than pages of printed text. It is proposed to devote one-fourth of our space to this purpose, and the size mentioned was purposely adopted so that we may not be cramped for room.

In its range for subject matter treated upon, the "Quarterly" is intended for engineers of all "denominations," and whatever is new in Civil Engineering in all its varied branches, hydraulic mining, hydrographical, or surveying, in military, naval or electric science, will find a place within its ample pages.

The following is a partial list of the contents of the first number. Several special papers are in preparation, and selections from the class papers coming to hand this month will complete the list:

"The Regulation of Rivers and Water-Ways, with a view to the Prevention of Floods." Translated from the German by the Institution of Civil Engineers, London. *Illustrated.*

"Account of Some Tests of Riveted Joints for Boiler Work." From selected papers of the Institution of Civil Engineers, the experiments being by David Kirkaldy. *Illustrated.*

"On the Care and Maintenance of Iron Bridges." By H. D. Blunden, Assistant Engineer Erie Railway, with discussion by Theodore Cooper, C. E. From the December Transactions of the American Society of Civil Engineers.

"Asphalt Mortar." Translated from the *Moniteur Industriel.*

"Notes on the Manufacture of Steel Castings." A paper read before the Iron and Steel Institute at Vienna.

"Corrosion in Steam Boilers." A paper read at the 23d session of the Institution of Naval Architects.

"Railways in Time of War." *Illustrated.* From *Engineering.*

"Wharf Moorings." *Illustrated.* From *Engineering.*

"Modern Ordnance." From *Engineering.*

"The Use of Concrete in Marine Construction." *Illustrated.* From *Engineering.*

"On the Use of Building Stones." From *The London Architect.*

"Failure of the Foundation for an Iron Lighthouse at the Mouth of the Weser." Translated from "Les Annales des Travaux Publics." *Illustrated.*

"The Corinth Canal." *Illustrated.* From the *Gazdasdgi Mérnök* (Hungarian).

"The Bell-Coleman Dry Cold-Air Machine." *Illustrated.* From *Engineering.*

"The Lauer System of Submarine Blasting." *Illustrated.* From *Engineering.*

"The Severn Tunnel." *Illustrated.* Condensed from *Engineering.*

"The Metropolitan Railway at Vienna." *Illustrated.* From *Engineering* and the London *Standard.*

"Richards' Water Meter." *Illustrated.* From *Engineering.*

"The Bender and Galatz Military Railway." *Illustrated.* From *Engineering.*

"An Old Water Clock." *Illustrated.* From *Engineering.*

"The Flensburg Water-Works." *Illustrated.* From *Engineering.*

"Compressed Air Tramways." Paper read before the British Association. *Illustrated.*

"Wind Mills." Read before the American Society of Mechanical Engineers. *Illustrated.*

"The Kinzua Viaduct." *Illustrated.* From *Railroad Gazette.*

"The Hercules Dredge." *Illustrated.* From *Engineering News.*

"Bridge Floors." By Jno. C. Bland, Assistant Engineer, Philadelphia Bridge Works. Written for *Engineering News Quarterly.*

"Engineering Recreations." By Prof. Mansfield Merriman. Being short articles on a number of subjects, many relating to odd and curious facts in surveying and engineering. Written for *Engineering News Quarterly.*

"The Industrial Situation." A review of markets and of the condition of the country, with special reference to the needs of engineers and contractors. Prepared specially for *Engineering News Quarterly.*

"Lists of New Publications," etc.

"Duty Trial of Gaskill Compound Pumping Engine at Saratoga Springs."

"The Val du St. Leger Viaduct on the Paris Belt Railway." *Illustrated.* From *Le Génie Civil.*

"The Sinking of Two Shafts at Marsden." From the Institution of Civil Engineers.

Time has been a wanting element in the preparation of this first copy, but as our arrangements for the future become more perfect, we will be enabled to present a still more useful and varied selection than that set forth in the above list. We have at hand the best available sources of information, and can add much more; and if we only do not err in judgment in culling from this rich and almost untilled field, each succeeding number should be a volume in itself of all in the engineering progress of the world that is of general interest.

The price of the ENGINEERING NEWS QUARTERLY will be four dollars per annum, three dollars to subscribers to ENGINEERING NEWS, or one dollar and twenty-five cents per number.

A list of the more important of the engineering publications now received at the office of this journal:

American Society of Civil Engineers.
Boston Society of Civil Engineers.
Civil Engineers' Club of Cleveland.
Engineers' Club of Philadelphia.
Engineers' Club of St. Louis.
Engineers' Society of Western Penna.
Essayons' Club, Corps of Engineers, U. S. A.
American Society of Mechanical Engineers.
Western Society of Engineers.
American Institute of Mining Engineers.
Pi Eta Scientific Society.
Surveyors and Engineers' Society of Ohio.
Surveyors and Engineers' Society of Michigan.

All the best American weeklies devoted to railroads and engineering in all its branches, and to architecture.

The Engineering, London.
The Engineer, London.
Proceedings of the Institution of C. E., London.
Proceedings of the Society of Engineers, London.
Nature, London.
The Architect, London.
The Contract Journal, London.
Annales des Ponts et Chaussée, Paris.
Memoires et Compte Rendu des Travaux de la Société des Ingenieurs Civils, Paris.
Genie Civile, Paris.
Moniteur Industriel, Paris.
Bulletin du Canal Interoceanique, Paris.
Le Fer, Paris.
Les Annales des Travaux Publics, Paris.
Revue Générale des Chemins de Fer, Paris.
Wochenshcrift des Osterreichischen, Vienna.
Schweizerisches Gewerbe-Blatt, Zurich.
Schweizerisches Bauzeitung, Zurich.

THE PUBLIC WORKS OF WASHINGTON, D.C.

We have just received the annual report of the "Operations of the Engineer Department of the District of Columbia." The report is well illustrated by maps and plans, as is to be expected from its source of issue, and its contents are interesting and valuable. Major Garrett J. Lydecker, U. S. Engs., is the Chief Engineer Commissioner, and Capt. R. L. Hoxie, and Lieut. F. Y. Greene, Corps of U. S. Engs., are the Asst. Commissioners.

We give an abstract of some of the principal matters treated upon.

The water supply of Washington and Georgetown has been liberally provided for by the act of Congress of July 15, 1882, appropriating $1,485,279.30 for the completion of the dam at Great Falls, the construction of a suitable aqueduct from the distributing reservoir to a point on the high grounds above Boundary, near Sixth st., extended, and the construction at this point of an additional reservoir. When these works are completed the water famine now existing must cease for many years. It is not a scarcity of water in the source of supply that afflicts the people of Washington, and the existing mains would bring to the city twice the present consumption; but the growth of the city lately has been largely upon the elevated ground, and the present trouble is due to loss of head. The high service supply by means of the stand-pipe erected in 1878 is already exhausted.

A practical system of intermittent supply is recommended, and at times in the past has actually been resorted to as preferable to the existing condition of affairs.

One of the questions not yet accurately settled by the authorities is, where does the water go to that now passes into the city? The entire supply of Washington crosses Rock Creek in two 48-in. mains that constitute the arch of the Aqueduct Bridge. A self-recording water-gauge is connected with these mains at the bridge, and registers the pressure under which the water flows into the city. The course of pressure so recorded is almost a straight line throughout the 24 hours, the pressure increasing only about two pounds during the night. It is thus shown that the quantity of water which flows into the city at night is but little less than the day consumption, in other words, it is probable that not less than 10,000,000 gallons of water flows in at a time when little or no consumption should be reasonably expected. The mains have not to be refilled during the night for they are not emptied, and as leaking would be uniform by day or night, it cannot be accounted for on that score; besides a serious leak soon manifests itself in the stiff, retentive clay underlying the city.

Work is progressing on the boundary intercepting storm sewer at three points under as many contractors. The rate of progress, which is un-

questionably slow, is probably due to the competition among bidders, which puts the price of work at a minimum. The tendency is to make the contractor apprehensive of loss, and engenders a mistaken economy. The amount of the annual appropriations is also too small, as it will not justify a contractor in the purchase of such outfit as would be warranted by the immediate appropriation of the whole cost of the work, to be done under one contract.

By the report on the streets and roads of the District of Columbia we find that $589,355 has been expended during the fiscal year ending June 30, 1882. The principal work done has been the replacement of the worthless wooden pavements. On July 1, 1878, there was 790,000 sq. yds of wooden pavement in Washington; on July 1, 1882, all of this had been replaced by a more durable material except 272,559 sq. yds.; it is expected that 105,000 sq. yds. of this remainder will be removed in the present fiscal year. The new pavement laid since 1878 is made up as follows: 3.0,078 sq. yds. asphalt pavement, at a cost of $607,998.76; 165,296 yds. granite block, costing $363,255.65, and 9,244 sq. yds. of asphalt block, at $18,329.72. The granite block, cemented in the joints with tar and gravel, so as to be thoroughly water-proof, was used on all streets of heavy business travel or steep grades. The asphalt pavement was adopted on the streets where the travel was uniformly distributed and the grades not too steep. It consisted of a solid base of concrete masonry, six inches thick, protected and covered by a wearing surface 2½ in. thick, composed of a mixture of sand and powdered stone, cemented by refined asphalt from Trinidad. The natural bituminous limestones of France were distinctly rejected, as being too slippery, independent of the fact that they were far more costly than the Trinidad asphalt. The average cost of the three classes of pavement used, per square yard, is shown by the following table, covering a period of 4½ years.

	Granite block.	Asphalt.	Asphalt block.
1878-79	$2.15	$1.80	$2.37
1879-80	1.90	1.47	1.87
1880-81	1.87	1.85	1.76
1881-82	2.40	2.09	1.90
1882-83	2.58	2.26	2.19

This is believed to be nearly one-fourth less than the ruling rates in other cities during the same period. The average cost of replacing the wooden pavements has been $2 per square yard, including all incidental work, such as adjusting curbs and sidewalks, building drains, etc. All new pavement was guaranteed for 5 years by the contractor, 10 per cent. being held from him for that time.

The concrete pavement laid previous to 1878 was composed of broken stone, pebbles, sand, and powdered stone, cemented by some of the bituminous products of coal tar. These products slowly volatilize in the air, resulting in a gradual disintegration of the pavement. Hence they are inferior to the Trinidad asphalt, and are no longer used. Many of these pavements, however, have made very durable roadways, and are in excellent order after seven years' use.

An excellent map accompanies the report, showing in varied colors the different classes of roadway material used in the 230 miles of streets in Washington.

Considerable space is devoted to the discussion of plans for re-arranging the railroad lines within the city limits, so as to sink them as much as possible below the street level, or take them through tunnels. If the plans should be adopted, the total length of tracks within the city would be 4½ miles, 2 miles of which would be underground.

CHESTER B. DAVIS, Mem. A. Soc. C. E., who has just successfully completed the construction of the Madison, Wis., water-works, and who is spending a few days in this city, was at the rooms of the society on Wednesday evening. Mr. DAVIS is giving almost exclusive attention to hydraulic engineering.

THE GREAT WEATHER SCARE.

Under the shrewd but comparatively harmless method of securing free advertising for his almanac, the original Canadian weather prophet "cheeked it" for several years with profit to himself and mild disgust to those who knew him. He knows as much about the weather to-morrow as anybody who studies a Signal Service Chart of to-day, and no more. But his success in selling almanacs has, like all other successful schemes, stimulated imitators, until the latest Canadian nuisance in the weather predicting business—Wiggins—has succeeded in doing a great deal of mischief. This fellow in December predicted as follow:

"A great storm will strike this planet on the 9th of March next. It will first be felt in the northern Pacific, and will cross the meridian of Ottawa at noon (5 o'clock, P. M., London time) of Sunday, March 11, 1883. No vessel smaller than a Cunarder will be able to live in this tempest. India, the south of Europe, England, and especially the North American Continent, will be the theatre of its ravages. As all the lowlands on the Atlantic will be submerged, I advise shipbuilders to place their prospective vessels high up on the stocks; and farmers having loose valuables, as hay, cattle, etc., to remove them to a place of safety. I beg further most respectfully to appeal to the honorable the Minister of Marine, that he will peremptorily order up the storm signals on all the Canadian coast no later than the 20th of February, and thus permit no vessels to leave harbor. If this is not done, hundreds of lives will be lost and millions of dollars worth of property destroyed."

Wiggins wrote the President of the United States about his storm, and ever since he has been advertised, free of expense, to his very heart's content. His success must make Vennor and DeVoe look sick through envy. Wiggins' almanac appeared in due time, and is now on sale in every book-stall in this city, with its pages opened at the ominous 9th of March.

As we write, at 11 A. M. on the 9th, the weather is superb; it is a clear, bright, sunny day, with not a cloud in sight, and hardly enough wind to carry away the smoke from the chimneys. But all along the seacoast the fishermen are lying idle, awaiting the storm. The fishermen of Canarsie and Rockaway yesterday drew their fishing boats far up on the beach, and hauled away their tackle to places of shelter. The Long Branch fishermen followed their example. At noon it was reported to the Fulton Market fish dealers that the entire fishing fleets of Gloucester and Boston, numbering nearly 100 fishing vessels, had also been "laid by" until after the date named for the storm. This action, fish dealers estimate, will cause a loss of about $30,000 to the fishermen. The only vessel that left this city yesterday to go on a fishing cruise was the smack Tempest. When the Jersey fishermen heard of her departure they shook their heads ominously.

"This Wiggins prophecy," exclaimed Mr. Eugene Blackford, "only shows what one big fool can accomplish by a crazy prognostication. It has scared the life out of the fishermen. The effect of their abandoning their occupation in this way will not be felt probably until the latter part of the month, and then only on the halibut supply. It will make that fish very scarce from the 19th to the 30th. It will not affect the other fresh fish, however, for the city draws the supply from so wide an area that nothing but such an impossible storm as Wiggins predicts could produce an appreciable fish famine. It is a great pity that the fishermen are so foolish as to heed Wiggins, for they can ill afford to lose the money these few days of idleness will deprive them of."

GLOUCESTER, March 8.—The fright over Wiggins' prediction of a storm on Sunday will cost Gloucester $150,000 by its effect on the fisheries. At least 100 sail will be hauled up here before the date set for the beginning of the storm, each of which will lose one trip to the George's Banks in the best season of the year for fishing. A great many storms that have been considered severe have not been as disastrous to the little fishing community as the prophecy of Wiggins.

HALIFAX, March 8.—Some of the city wharf proprietors, fearing the fulfilment of Wiggins' prediction, have notified the owners of goods in their custody that they will not be responsible for their safety during the coming week. The property in the stores on some of the wharves is also being removed from the lower to the upper stories.

Owing, it is said, to the refusal of American fishermen to go on the Banks again until the specified dates of Wiggins' storm are past, a fresh fish famine has been caused. Boston and New York orders have been received here for as large a supply of fish for these markets as it is possible to furnish.

OTTAWA, March 8.—The weather still continues cold. The thermometer to-day registers 15° below zero. The railways are still blocked, and mails are late.

As the time approaches for the great storm predicted by the prophet Wiggins, the interest becomes more intense. It is the general topic of conversation, and many timid persons are known to be prostrated with nervousness. Telegraphic reports from points in the United States that several women had become insane through fear have painfully affected Wiggins.

Wiggins says he regrets the coming of the storm, and wishes now that he had not predicted it. In the interest of science, however, he felt it to be a duty that he owed to his fellow creatures. He promises to publish to the world early next week the theory on which he based his prognostications.

It is to be hoped that the day of weather cranks is at an end. If Wiggins has accomplished such a result, then Wiggins, although a mischief maker, has not lived in vain. It is bad enough to be scared at the prospects of life in another world. Why should the "idle hands" that the devil is always enlisting in his service be allowed to multiply as rapidly as these Canadian almanac inventors are, to add to the miseries of life in the present?

PERSONAL.

MR. A. B. MENOCAL, of Nicaragua Canal fame, was at the meeting of the A. S. C. E., on Wednesday evening. He returned to Washington on Thursday.

JAMES O. MORSE, C. E., of Englewood, N. J., for many years the First Treasurer of the American Society of Civil Engineers, and influential in shaping the early policy of that Society, died suddenly at the United States Hotel, on the evening of the 8th. He was 65 years old, and for many years has been engaged in the manufacture of steam-heating pipes and fittings at 79 John street, this city. He leaves a considerable fortune.

C. H. MEYER, First Assistant Engineer of the New York Sewer Department, had a narrow escape from fire early Wednesday morning, by the burning of the Cambridge Flats, in which he lived with his mother and sister. With the other tenants, they escaped by the iron staircase at the rear of the building, but with only the clothing which they wore.

E. D. LEAVITT, JR., the designer of the celebrated "Leavitt" Pumping Engines, and also Chief Engineer of the Calumet & Heckla Mining Co., Lake Superior, has been retained by HENRY R. WORTHINGTON'S firm in this city as Consulting Engineer. Mr. LEAVITT is probably the leading Mechanical Engineer of this country.

HOWARD CONSTABLE, C. E., late Assistant Engineer in the construction of the Kinzua Viaduct, under Mr. CHANUTE as Chief Engineer, has been placed in charge of the interests of HENRY R. WORTHINGTON in the West, with headquarters at 709 Market St., St. Louis, Mo. Mr. CONSTABLE is one of the most popular young Civil Engineers of the day; he is now making a specialty of hydraulic engineering, and with his acknowledged habits of persevering application, there is no doubt of his future success. Mr. CONSTABLE will take charge of the WORTHINGTON exhibit at the coming exhibition of railroad appliances in Chicago.

ELECTIONS AND APPOINTMENTS.

INTERNATIONAL CONSTRUCTON CO.—The officers of this company, which is building the Southern Pacific extension in Mexico, are: President, C. P. HUNTINGTON; Secretary and Treasurer J. E. GATES; agent in Mexico, GEN. JOHN B. FRISBIE; Chief Engineer, ROBERT B. GORSUCH; Chief of Construction at Pedras Negras (in the North), JAMES CONVERSE.

MR. S. B. WHITING has been appointed General Manager of the Philadelphia & Reading Coal & Iron Company, the position of chief engineer having been discontinued.

CORRESPONDENCE.

THE FLOW OF WATER THROUGH PIPES—CORRECTION.

CINCINNATI, March 7, 1883.

EDITOR ENGINEERING NEWS:

In your issue of March 3, the formula copied from Wm. J. McAlpine's article on the "Flow of Water through Pipes," was *misprinted*. *It should have been*

$$\text{Veloc. per second} = \sqrt{\frac{R\,S}{0.000057\left(1+\frac{0.23}{R}\right)}}$$

This table agrees with his formula, as do the results given in your last issue. Respectfully,

PAX.

FLOW OF WATER THROUGH PIPES.

EDITOR ENGINEERING NEWS:

In your last number a correspondent calls attention to a discrepancy in the results of computations for flow of water in clean and tuberculated pipe, the latter by Wm. J. McAlpine and published in your journal for Jan. 13, 1883, compared with computations made by the writer in question. Both writers have professed to use the formula deduced by Darcy from experiments made by him under the auspices of the French government. Mr. McAlpine uses a formula with which I am not familiar, as applied to pipes under pressure, and your correspondent "Pax" uses a formula quoted from my work on "Sewers for Populous Districts." The former he states as for pipe roughened by use, and the latter for clean pipe, and the discrepancy appears in the discharge of the former being greater than in the latter! and remarks that "an explanation would not be out of place." I beg leave, therefore, to explain the origin of the formula recommended by me, but decline to discuss the value of the formula as used by Mr. McAlpine for the reasons above stated.

Mr. Francis presented a paper before the A. S. Civ. Engr., published in their Transactions No. XXXVII, 1872, on the flow of water through both old and new cast-iron pipes, giving tables of the experiments of Darcy, and the formula deduced by the latter, reduced to English measures. The formula for clean pipes is as follows:

$$i = (0.00370874\,d + 0.00372672)\,\frac{v^2}{d^2}$$

i = loss of head per foot of length of pipe, in feet, or fall divided by length.

v = mean velocity of flow in feet per second.

d = diameter of pipe in inches.

Without sensibly affecting results, he simplifies this equation as follows:

$$i = 0.00371\,(d+1)\,\frac{v^2}{d^2}$$

Putting H for the head required to overcome the resistance by friction in a straight pipe, and L for its length, then $i = \frac{H}{L}$, substituting and resolving for v, we have

$$v = \sqrt{\frac{d^2\,H}{0.00371\,(d+1)\,L}}$$

From the reputation of Mr. Francis for painstaking accuracy in matters pertaining to hydraulics, I accepted this formula as embodying the results of Darcy's experiments on pipes, and have used it since with every confidence in its accuracy. The factor in the denominator proposed for use for roughened pipe is from a mean of experiments = 0.0084.

When the Loch Katrine water-works for Glasgow were being extended some years since, a portion of the distance was carried over low grounds by a cast-iron trough, 6¼ ft. deep and 8 ft. in width, supported on masonry piers, and giving good opportunity to determine the daily flow. By this and other means, it was found that the cast-iron pipes, 4 ft. in diameter, which, with a fall of 1 in 1,056 on the rest of the line, has been computed to carry 21,000,000 gallons, were really discharging daily 23,430,000 gallons. The engineer, Mr. Gale, brought the matter to Prof. Rankine's attention, who in a paper and subsequent discussion before the Institution of Engineers of Scotland, March 17, 1869, uses this language: "It might be interesting to the Institution to know that there was a formula which agreed exactly with the result of Mr. Gates' experiments. Suppose that before these four-feet pipes were laid the probable discharge had been calculated by Darcy's formula, the result would not have differed by *one part in a thousand* from the actual discharge, which was 23,430,000 gallons daily. This went to show that they now possessed a general formula for the flow of water in pipes and the resistance to that flow, which applied to large as well as to small pipes. It would apply to pipes of an inch in diameter and from Mr. Gates' experiments they would see that it also applied to pipes four *feet* in diameter."

The Glasgow pipes had been coated by Dr. Smith's process, and were treated as clean pipes and calculated by the formula quoted by "Pax." I think that Darcy's experiments, conducted as they were under circumstances which contributed in every way to inspire confidence.———Mr. Francis' labors in presenting this formula to us in an English dress, with the prestige growing out of of his well-known capacity for careful investigation and computation, and Professor Rankine's indorsement of its applicability to all conditions of pipe discharge up to 4 ft. diameter, must be considered as establishing the practical value of *this* special formula for the flow through *iron pipes*. As to the table and formula used by Mr. McAlpine, he says: "They are from the second category of Darcy's *channel formula*, and which he (Mr. McAlpine) considered as applicable to pipe which has been oxidated internally by a few years' use." As I understand this, they were from Darcy and Bazin on *channels*.

The experiments to which I refer were made on small cast-iron pipe, in which the smoothness or otherwise of the internal surface was an important factor, as shown in the experiments—and experience has shown that they can be relied upon as high as 4 ft. diameter, but when the diameter becomes as great as 30 ft., the condition of the surface in its effects on the discharge of such a pipe is certainly as yet in the region of the unknown. However, in my ignorance of any experiments by Darcy on pipes of 30 ft. diameter, or of anything to justify the application thereto of any of the formulæ of Darcy's for iron pipes running full, I would not venture to apply his channel formula to any small pipe flow.

J. W. ADAMS,

155 Congress street, Brooklyn.

CHESAPEAKE & OHIO R. R.—The Big Bend tunnel on this road is 7½ miles east of Hinton, W. Va. It is 6,400 feet long, and when first opened was arched with timber, the company intending to replace it with brick-work. For two years past the brick-work has been pushed forward as rapidly as possible, but the workmen have often to stop to allow trains to pass, and so cannot make great speed. They have, however, been working day and night from both ends, and have finished 1,800 feet of brick arching. Recently a wrecking-car with a derrick on it attempted to pass through without the derrick being lowered and some 60 feet on the old wooden archway was torn down, liberating a large quantity of earth. Much delay was caused by the accident.

SPECIFICATIONS FOR STANDARD PAVEMENTS.

(From Annual Report U. S. Eng. Dept. of the District of Columbia, 1882).

Specifications for Granite Paving Blocks, 1882.

QUALITY.

First. The blocks may be of any syenite or granite equal in hardness to what is known as Quincy granite, but they must be of a uniform grain and texture, without lamination or stratification, and free from excess of mica or felspar; hard basaltic stone that will take a smooth polish under traffic will not be accepted. Soft or weather-worn stones obtained from the surface of the quarry will not be accepted.

SIZE.

Second. The blocks must be of the following dimensions, viz.: In length, not more than 8 nor less than 6 inches; in width, not more than 5 nor less than 3 inches; in depth, not more than 6 nor less than 5½ inches. The size preferred is 7 inches long, 4 inches wide and 6 inches deep. They must be sufficiently dressed to present rectangular faces, with straight edges on top, bottom and sides, and all blocks whose faces vary more than half an inch from a rectangular shape will be rejected. The sides and ends of the blocks must be so dressed that they will make close-fitting joints, and any block which has projections or knobs larger than half an inch will be rejected.

CONDITIONS OF DELIVERY.

Third. The blocks will be carefully inspected upon delivery by the engineer commissioner or his agents, and all blocks which do not conform to the foregoing specifications in size or quality must be immediately removed by the contractor at his own expense. The contractor must also furnish at his own expense such laborers as may be deemed necessary by the engineer commissioner to assist his agents in inspecting and culling the blocks.

Fourth. All bids must be accompanied by a specimen block of the size and quality described in these specifications, labeled with the name of the bidder and the locality of the quarry; bids not accompanied by specimen blocks will not be accepted.

Specifications for Laying Granite Block Pavement, 1882.

1. The granite block pavement will be laid on a foundation of gravel and sand, with filling of hot paving cement from coal tar.

2. The stone blocks will be furnished by the District at ———, and must be hauled to the street at the contractor's expense.

3. All wood blocks, etc., necessary to be removed shall be taken up and removed immediately from the line of the work. The subsoil or other matter is then to be excavated and removed to a depth of twelve and one-half (12½) inches below the top line of the proposed new pavement, when fully rammed. Should there be any spongy material or vegetable matter in the bed thus prepared, all such material will be removed and the space filled with clean gravel or sand. Care must be taken in excavating to preserve the proper crown, which will be sensible the same as at present, where the street is paved with wood or stone blocks. All holes and inequalities to be filled to proper level with sand or gravel only, such filling to be well and faithfully compacted by ramming or rolling.

4. Upon the foundation as above is to be laid a bed of fine bank gravel, to be approved by the engineer commissioner, 4 in. in depth when compressed, to be screened from all pebbles measuring more than 1½ in. in their largest dimensions, and to be thoroughly rolled and rammed. Upon this will be laid a bed of fine, sharp, washed sand, thoroughly dry, 3 in. in thickness, to serve as a bed for the blocks, which will be laid directly upon and imbedded in it with close joints. The stone blocks are to be laid at right-angles with the line of the street, with such crown as the engineer commissioner may direct; each course to be of blocks of uniform width and depth, and so laid that longitudinal joints shall be broken by a lap of at least 2 in. When thus laid, the blocks shall be immediately covered with clean, fine, hot gravel in proper quantities, and raked until all the joints become filled therewith, and the blocks will then be carefully rammed to a firm unyielding bed, with uniform surface, and with proper grade and crown. There will then be poured into the joints at a temperature of 300° Fahrenheit, saving cement of proper consistency, to be approved by the engineer commissioner, to be obtained by the direct distillation of coal tar, and to be the residuum therefrom. The cement required is ordinarily numbered between 5 and 6 at the manufactory. It will be poured into the joints of the pavement until the sand beneath and the gravel between the blocks will absorb no more and the joints are filled flush with the upper surface of the pavement. Dry, hot gravel not larger than ¼ of an inch in any dimension will then be poured along the joints filled with paving cement as just described, and will be consolidated by tapping

with a light rammer. Not less than 3½ gallons of paving cement to each square yard of pavement will be required; this quantity must be brought upon the grounds, upon the line of the work, and whatever may remain after the completion of the work will be the property of the District of Columbia, and will be hauled to the Sixth street property-yard at the expense of the contractors. Any wastage of paving cement by pouring over the surface of the pavement instead of between the blocks will be estimated and deducted from the amount reported to have been used, and any such wastage of paving cement remaining upon the surface of the pavement must be covered with a sufficient quantity of fine dry gravel to absorb it.

(SPECIFICATIONS TO BE CONTINUED.)

NEWS OF THE WEEK.

ILLINOIS NORTHERN R. R. Co.—This company has filed articles in Illinois. It is proposed to construct a railroad, commencing at Peoria, by the way of the city of Sterling, Ill., to Milwaukee, Wis., the principal offices to be located at Sterling, in Whitesides County. The capital stock is $100,000, and the incorporators are Bradford C. Church, Thomas A. Galt, George S. Tracy, Samuel Patterson, William M. Kilgore, Taylor Williams, and John G. McMahan.

WABASH, PADUCAH & SOUTHERN R. R.—This new road will soon be built in southern Illinois. It will run from a point on the G. T. & C. Coal Road, in Williamson County, to Paducah, K. Articles of incorporation have been filed, and the capital stock is $600,000.

PENNSYLVANIA R. R.—It is stated that the engineers of this road are surveying a branch from Phœnixville to Allentown, Pa.

IRON PIPE CONTRACT.—The contract for making cast-iron mains for Durango, Col., has been taken by the Cincinnati & Newport Iron & Pipe Company, of Newport, Ky.

CLEARFIELD, CHEST CREEK & WESTERN R. R.—This road has been chartered in Pennsylvania to run from Clearfield to the mouth of Chest Creek, on the Susquehanna Run, a distance of 30 miles. Capital, $300,000. The office will be at Williamsport. William Seaman is the President.

ELECTRIC LIGHT.—The mast for the electric light at Minneapolis, Minn., has been finished and the current turned on. The light is satisfactory.

BRICK CONTRACT LET.—Philadelphia has let a contract for a large quantity of brick at $7.95 per thousand.

PHILADELPHIA & CHESTER COUNTY R. R.—Daniel Kelly has been awarded the contract for completing this road. A large force of laborers have reached a point between Abbottsford and Newtown Square and have begun work. The rails have been ordered and it has been decided to build iron bridges, with stone work sufficiently wide to admit of double track. Persons in authority say that the line will be extended to Unionville, a point nine mile southwest of this place, as soon as the grading to West Chester has been completed.

HANNIBAL & ST. JOSEPH R. R.—The extension of this road from Quincy to Chicago has been decided upon. A survey of the route was made a year or two ago. The contract for building it will be made very soon, it is said, and the surveyors of Brown, Howard & Co. will inspect the proposed route early next spring. It is said by officers of the Hannibal & St. Joseph that the line can be built easily for $20,000 a mile. It will require not more than a year to complete the road.

BRIDGE AT KANSAS CITY.—The bill authorizing the construction of a bridge over the Missouri at this point has been passed.

OREGON POST LINE.—A dispatch from Salt Lake, Utah, states that Mr. Hendricks, a contractor on this line, is employing over 300 men on the grading on the west side of Snake River along the valley of Burnt River.

ILLINOIS NORTHERN R. R. Co.—This road has been incorporated in Illinois. It is proposed to construct a railroad commencing at Peoria, by the way of the city of Sterling, in this State to Milwaukee, Wis. The principal offices are to be located in at Sterling, Whiteside County. The capital stock is $100,000, and the incorporators are Bradford C. Church, Thos. A. Galt, Geo. S. Tracey, Samuel Patterson, Wm. M. Kilgour, Taylor Williams and John G. Mamahan.

NEW IOWA ROAD.—A road is projected to run from McGregor to Nebraska City and the track will be laid from Marshalltown to Waterloo by June 1.

ELEVATED R. R. FOR BOSTON.—The Massachusetts Legislative Committee on Street Railways has voted in favor of reporting a charter for the Meigs Elevated Railroad in Boston.

WATER-WORKS, TYLER, TEX.—The water-works for this place have been completed.

ELEVATED R. R. FOR NEW ORLEANS DEFEATED.—The ordinance for building an elevated railroad along the levee has been defeated in the city council.

ERIE & WYOMING VALLEY R. R.—The survey of the road has been completed. The project is the joint enterprise of the Erie and the Pennsylvania Coal Company, and John B. Smith, General Superintendent of the latter corporation, has been chosen President of the Erie & Wyoming. Ground will be broken for the new road on the 10th of next month, and it will be completed in less than a year.

ST. LOUIS & SAN FRANCISCO R. R.—Contracts have been let for 35 miles of the White River branch, which leaves but twenty miles more to be let to take the branch to White River, or, rather, Forsyth, the point where the line is to cross the stream. The point to which the contract is let has been named Chadwick, and a town is to be laid out there.

TEXAS MIDLAND R. R.—This road has been chartered and will run from Waco to Palestine, Texas. All surveys have been completed.

NEW HOTEL.—Plans have been drawn for a $50,000 hotel at Rapid City, Dak.

WATER SUPPLY OF THIS CITY.—Mayor Edson's Water Supply Committee sent their report to the State Senate Thursday. The report favors the building of a new aqueduct by a commisson.

NEW WATER-WORKS COMPANY.—The Manzanita Water Company filed articles of incorporation with the County Clerk yesterday. To supply water to cities and towns in San Mateo and Santa Clara counties and to the city of San Francisco is declared to be the object of the company's incorporation. The Directors are Ariel Lathorp, C. G. Lathorp, F. S. Douty, J. L. Rathbone and William Harney. Two hundred and fifty thousand dollars of the $1,000,000 capital stock has already been subscribed.—*San Francisco (Cal.) Chronicle.*

PORTSMOUTH VA. WATER-WORKS.—The contract for the entire work, including buildings, pumps, conduit and distribution, has been let to John F. Ward, Esq., of Jersey City, N. J. The Hon. Marshall Parks, of Norfolk, Va., is the President of the Water Co., and D. McN. Stauffer the engineer. Work has already been commenced, by shipping and laying of distribution pipe.

RAILROADS IN MAINE.—A narrow-gauge railroad from Bangor to Milo, Me., 40 miles in a northwesterly direction, is contemplated by a party of capitalists and constructors. The road would be 2 ft. gauge, and pass through Six-Mile Falls, Kenduskeath, Corinth, Charleston and Atkinson and connect at Milo Junction with railway to Katahdin Iron Works. The road would cost but about $5,000 a mile.——James Gordon, who was one of the contractors for building the European & North American Railway, has a $200,000 contract from the International Railway on Lake Megantic, and has at the present time 300 men and 80 horses at work, and about one-third of this force is at work in Maine. It is expected that about 20 miles of that part of the road in Maine will be graded this year, and that the road will be completed to its connection with the European & North American Division of the Maine Central Railroad in 1885.

PITTSBURGH & WESTERN R. R.—The officials of this road announce that their line, 216 miles long, extending by one branch to Kane, Pa., and by another to New Castle, Pa., is completed, save a little work on a bridge at Foxburg. Twelve hundred workmen have been discharged.

NEW WESTERN UNION BUILDING.—A new building for the accommodation of this company will be built at Buffalo.

NEW YORK UNDERGROUND R.R.—The property and franchise of the New York Underground Railroad Company are to be sold at auction under a judgment of foreclosure obtained in the Superior Court by James H. Fay, trustee of a mortgage for $39,358.53 made by the company to secure debts due a number of firms and individuals.

SHAMOKIN, SUNBURY & LEWISBURG R. R.—Work on this branch of the Philadelphia & Reading was commenced on the 1st.

AMERICAN SHIP-BUILDING CO.—This company has filled articles of incorporation in this State. The incorporators are Henry H. Gorringe, Cornelius Vanderbilt and J. Fredrick Tams. The purposes of the new company are to build and repair vessels, to make and repair machinery for vessels, and to make and repair any articles used in the equipment and outfit of vessels, and generally to manufacture machinery of all kinds. In order to effect these purposes the company is empowered to purchase and lease real estate. Its capital is stated at $250,000, divided into 2,500 shares of $100 each, and it is to continue in existence for 50 years. Its Trustees for the first year are Henry H. Gorringe, Charles M. Fry, James A. Roosevelt, Henry C. Pedder and J. Frederick Tams. The place of the company's main operations is to be this city, but its manufacturing business may be carried on in all parts of the United States.

MEXICAN CENTRAL RAILROAD SECURITIES.—The entire subscription to the Mexican Central securities under circular No. 4 amounted, at the close of the books, to $7,229,500, or $1,197,000 more than was asked for.

PHILADELPHIA & LONG BRANCH RAILROAD.—The capital stock has been increased from $200,000 to $400,000.

THE IRON AND METAL MARKET.

PHILADELPHIA.

MERCHANT BAR.—There is an improving demand at 2@2¼c., according to quality. Nails are in active demand at $3.15@$3.30; Foundry Pig, $23@$25. Gray Forge, $20.50@$22; Steel Rails, $39@$40; Structural Iron, 2¼@2¾c.

Plate and Tank, 2¼c. for Tank to 4¼c. for Flange. Wrought Pipes 67½@70c. off.; Boiler Tubes, 55 off; Muck Bars, $36.50; Charcoal Blooms, $63@$65; Anthracite, $55; Old Rails, $25.50; Scrap Iron, $26@58. An improvement is observed in the trade this week, growing out of settled tariff duties. Consumers are short of iron and an active demand is confidently anticipated.

PITTSBURGH.

Transactions in iron during the past 48 hours indicate that there is an improving tendency at work, and manufacturers and consumers are in better spirits than they have been since the opening of the year. Different opinions are expressed as to the probability of the spring trade, but all agree in expressing satisfaction that tariff legislation has been fixed, and that it is likely to be permanent for a year or two. Neutral Mill Iron is under better inquiry at $19.50@$20; Red Short Mill, $21.50@$22; Foundry, Native Ore, $22@22.50; Car Wheels, $30; Bessemer, $22.50; Muck Bars, $35; Manufactured Iron, 1.90@2.10c.; Gas and Steam Pipes, 70 and 5 off; Boiler Tubes, $55; Steel Rails, $40; Spikes, $2.75; Old Rails, $26.50@$27 for American; Selected Scrap, $27@$28. The situation is improving daily, and buyers are in the market since Monday making inquiries, and in a good many cases placing orders for considerable amounts.

ABSTRACT OF BIDS FOR DREDGING ON THE MIDDLE NEEBISH, ST. MARY'S RIVER, MICHIGAN.

Received and opened by Major F. U. Farquhar, Corps of Engineers U. S. A., on February 28, 1883, in accordance with advertisement dated January 30, 1883.

No. of Bids.	Names of Bidders.	Residence.	Upper Section.		Middle Section.		Lower Section.	
			Bank Measure. Per cubic yard.	Scow Measure. Per cubic yard.	Bank Measure. Per cubic yard.	Scow Measure. Per cubic yard.	Bank Measure. Per cubic yard.	Scow Measure. Per cubic yard.
			Approximate quantity, 100,000 cu. yds.	Approximate quantity, 125,000 cu. yds.	Approximate quantity, 100,000 cu. yds.	Approximate quantity, 140,000 cu. yds.	Approximate quantity, 100,000 cu. yds.	Approximate quantity, 140,000 cu. yds.
1	John Hickler	Buffalo, N. Y.	$0.72	$0.62	$0.72	$0.62	$0.72	$0.62
2	Williams & Upham	L'Anse, Mich.	.75	.60	.75	.60	.75	.60
3	David W. McConnell	Buffalo, N. Y.	.79	.70	.79	.70	.85	.75
4	Harry Fox & Co.	Chicago, Ill.	.90	.67	.90	.67	.90	.67
5	Charles S. Barker.	Sault Ste. Marie, Mich.	.95	.63	1.25	.70	1.25	.70
6	James Rooney	Toledo, Ohio.	1.00	.68	1.00	.68	1.00	.68
7	Carkin, Stickney & Cram.	East Saginaw, Mich.	1.25	.65	1.25	.65	1.25	.65
8	Chicago Dredging Co.	Chicago, Ill.	....	.72	....	.72	....	.72
9	Norris G. Dodge.	Little Falls, N. Y.	....	.75	....	.85	....	.90
10	Christian Schwarz.	Fort Howard, Wis.	....	.66	....	.82	....	.82
11	Horatio Truman	Manitowoc, Wis.	....	.83	....	.83	....	.83
12	Greens Dredging Co.	Chicago, Ill.	....	.71	....	....	....	....
13	Edward Moore	Portland, Me.	....	1.65	....	....	....	....

TRUSS BRIDGES.

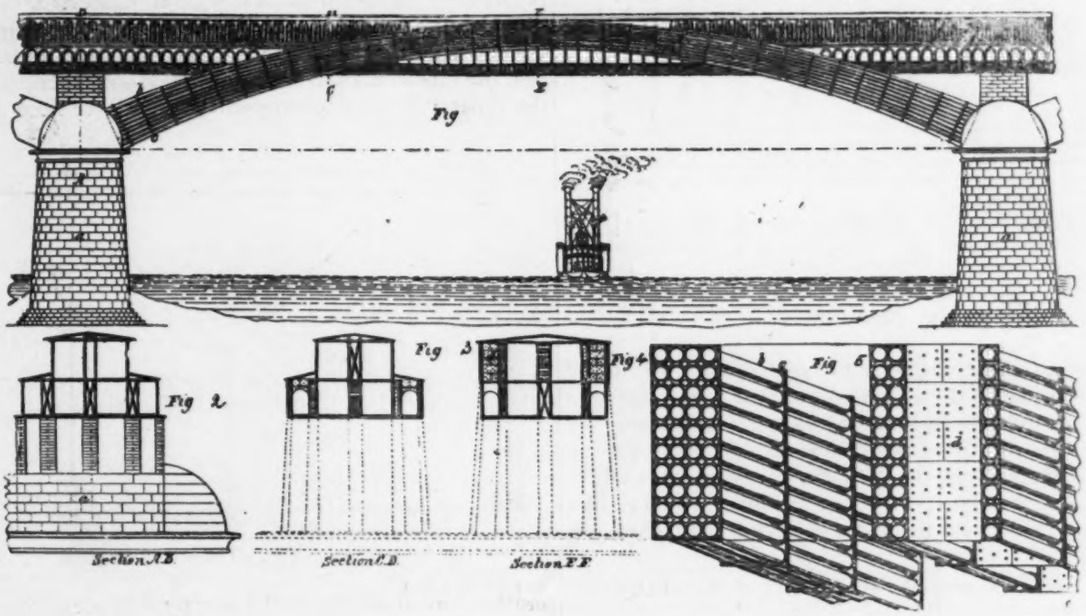
AN ILLUSTRATED HISTORICAL DESCRIPTION OF ALL EXPIRED PATENTS ON TRUSS BRIDGES, WHICH UNDER THE LAW ARE NOW PUBLIC PROPERTY AND FREE TO BE USED BY ANY ONE.

By F. B. Brock, Patent Attorney, Washington, D. C.

Fig. 1 is a side elevation representing a bridge of five hundred feet span. Figs. 2, 3 and 4 are detail sections. Fig. 5 is an enlarged perspective of a portion of the ranges belonging to one side of the bridge.

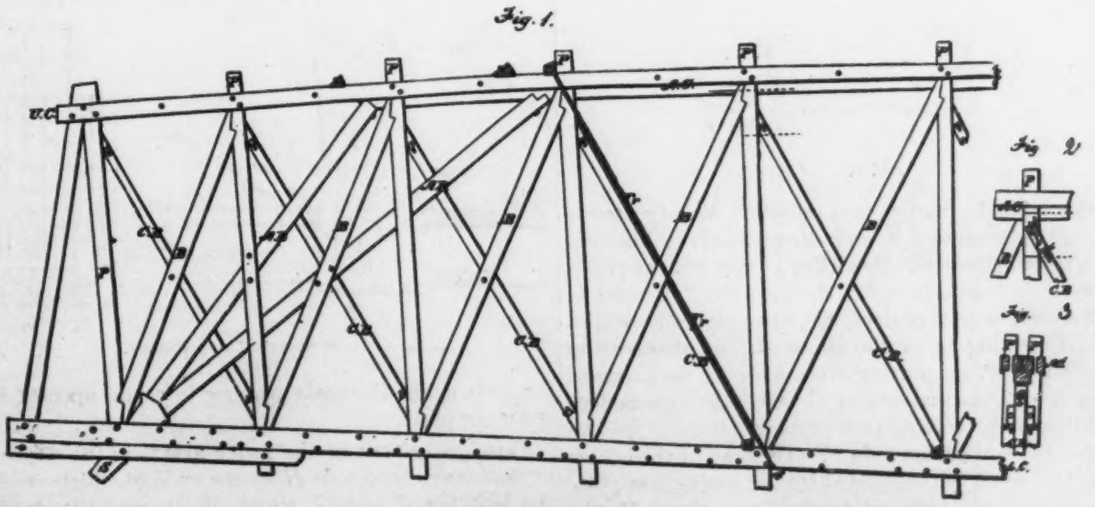
The piers *a* are of usual construction; *b* are tubes of cast iron extending from the crown towards the abutment on either side, increasing in size, substance and breadth of bearing. This construction slightly contracts the width of road-bed towards the center of the span. Where a parallel roadway is desired, the expansion of the tubes towards the abutment and contraction towards the crown may be wholly in a vertical direction, so that the tubing being cylindrical about the haunches of the arch assumes a gradually oval form both towards the crown and towards the abutments, the major diameter being horizontal at the center and vertical towards the ends of the arch; *c* are flat iron plates placed at stated distances radially in the arch for preventing lateral displacement of the tubes; *d* are boiler iron brace plates.

Jan. 20, 1857, D. C. McCallum devised a bridge the nature of which consists in combining the arch braces with the arched chord or beam, and the top surface of the abutment with the lower chord or tie, by means of a cast-iron shoe and the tension rods, whereby the thrust of the arched chord is thrown down upon the abutment, and any deflection in the lower chord is counteracted by an upward force at each end of the tension rods. The invention relates also to a method of lengthening or shortening the braces of a bridge truss by means of which the truss may be elevated or compressed as required.



ROGER'S BRIDGE.

The latter part of the invention is accomplished by an iron yoke *a*, an iron plate *b* on the end of the counter-braces, and the iron straining pieces *c c* and nuts *d d*, as shown in Figs. 2 and 3.

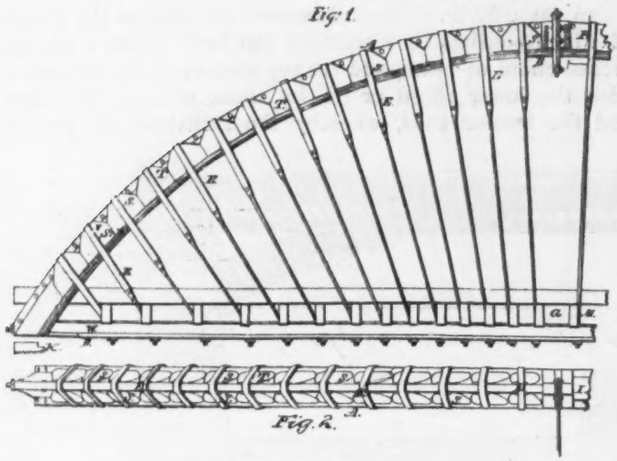


McCALLUM'S BRIDGE.

The posts *P* are in pairs. *V C* and *A C* is the upper arch chord. *L C* is the lower chord. *B* are the main braces; *C*

B, the counterbraces; *A B*, arch braces united in one cast iron shoe *S*, bearing against the abutment of the pier *Tr* are the tension chords.

McCallum asserts that the arched upper truss is a com-



MOSELY'S TRUSS BRIDGE.

ponent part of the truss acting in perfect unison with the rest of the bridge. He also states that it is customary to introduce an arch rib in bridges which in many cases fails to act in unison with the truss, hence there are two systems —the truss proper and the arch rib. It is extremely difficult to adjust the two systems, the failing of which results in a yielding in one system before the other can be brought into play.

Feb. 3, 1857, Thomas W. H. Mosely, of Kentucky, received protection under the law for a truss bridge.

Fig. 1 is a partial elevation, Fig. 2 a top, and Fig. 3 a detail view of Mosely's bridge.

The arches *A A* of his bridge are of compound character, and are built up of wrought iron in such a manner as to give the arch very long spans without excessive weight. A transverse section of this arch exhibits the form of an isosceles triangle, the base *B* of which is the chord of the arch. The plates *P* of the arch (Fig. 3) break joints with each other for the purpose of strength. For the purposes of additional strength to the triangular arch, a vertical plate *R* is used

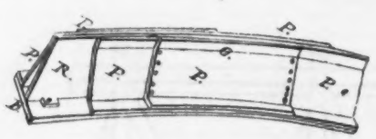


Fig. 3.

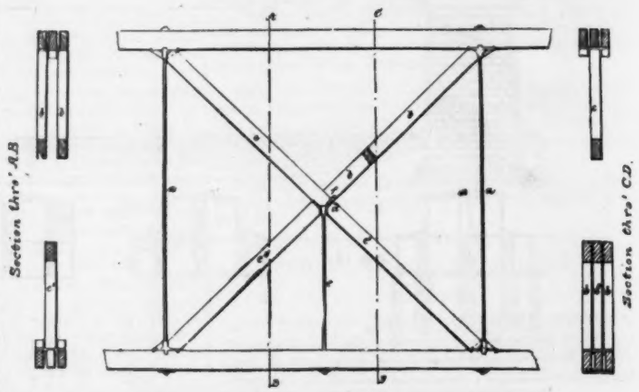
dividing the triangle, and bolted thereto. Mosely asserts that under a strain exerted in any direction upon this compound arch there is less risk of buckling of either of the plates than in any other structure for the purpose. In order to prevent all risk, however, of buckling, loose pieces or saddles *s s* are used, resting upon the plates *B*, and also bearing against the plates *P*, supporting each other by their edges, which come into contact as seen at *T*. Over the upper edges of the saddles, and receiving part pressure thereof, are the stirrups *E* of the suspension rods *F*. The floor of the bridge rests upon the chord *M*, supported by the suspension plate *D*. This plate is not fastened to the lower chord *M*, and the effect of which is that every load draws upon the whole arch in consequence of the sliding movement of the suspension plate under the chord.

March 3, 1857, Albert Fink, of Pennsylvania, received a patent for a truss bridge.

The invention consists in the use of an auxiliary truss between the main supports of a truss of the class commonly known as Howe's truss. The object is to save material and obtain greater strength by placing the braces of the truss in or near the angle of 45°, which, he says, is the most effective angle in which braces can act.

The auxiliary truss consists partly of a lower piece *c* of the counter-brace *c c'*, and partly of a piece *c''* which is placed in the middle space between the two main braces *b b*. The two braces *c' c''* meet in a casting *d* to which the suspension rod *e* is attached. A key *f* can be inserted, by means of which the length of the counter-brace can be adjusted.

Fink says that in trusses of the usual mode of construction the braces have to act in an angle approaching nearly the vertical in order to support the chords or floor at suffi-



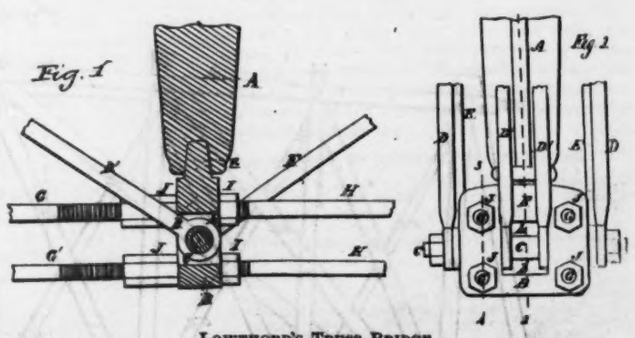
FINK'S TRUSS.

ciently close intervals, and a greater number of braces and suspension rods are thus necessary than are required in his construction.

June 30, 1857, Francis C. Lowthorp devised a straining device for truss bridges.

Fig. 1 is a sectional and Fig. 2 an end view of the device.

A is the lower portion of one of the vertical posts of the bridge. *B* is a straining plate having a projection *a* for entering the bottom of the post. The plate *B* is provided with a pin *C*, to which are jointed the end of the main diagonals *D* and *D'*, and the counter-diagonals *E*, the ends of



LOWTHORP'S TRUSS BRIDGE.

the two main diagonals passing into the opening *b* of the straining plate.

Through orifices in the latter also pass the screwed ends of the lower chord rods *H*, on the ends of which are screwed the lengthened nuts *J*, which also receive the chord rod *G G*. The rods *H* have nuts *I* which, with the nuts *J*, connect the opposite rods securely to the plate *B*. This device forms a simple and effective mode of attachment for the diagonal and vertical members of a truss bridge.

(TO BE CONTINUED.)